

TECLUB

Terrestrial **E**cosystems **C**arbon Cycle **L**and **U**se / LandCoverChange & **B**iodiversity

Meeting Summary

28-30 Oct 2014

Goddard Space Flight Center

Scott Goetz, Forrest Hall

NRC Decadal Survey

- National Research Council process to establish priorities for Earth Observation
- First NASA/NOAA DS undertaken in 2006
 - 15 new missions (3 tiers) recommended for NASA
 - 3 missions implemented (ICESat-2, SMAP, NISAR)
- New DS panels will meet in 2015
 - Sponsored by NASA, NOAA, and USGS
 - More emphasis on measurements, less on defining mission?
 - More emphasis on continuity observations?
 - Science communities defining **discipline priorities** as input to NRC panels

TECLUB Workshop Objectives

- Deliberate, describe and prioritize TECLUB measurement needs for the next decade
 - Terrestrial ecology
 - Biodiversity
 - Land Cover & Land Use Change
 - Carbon Cycle

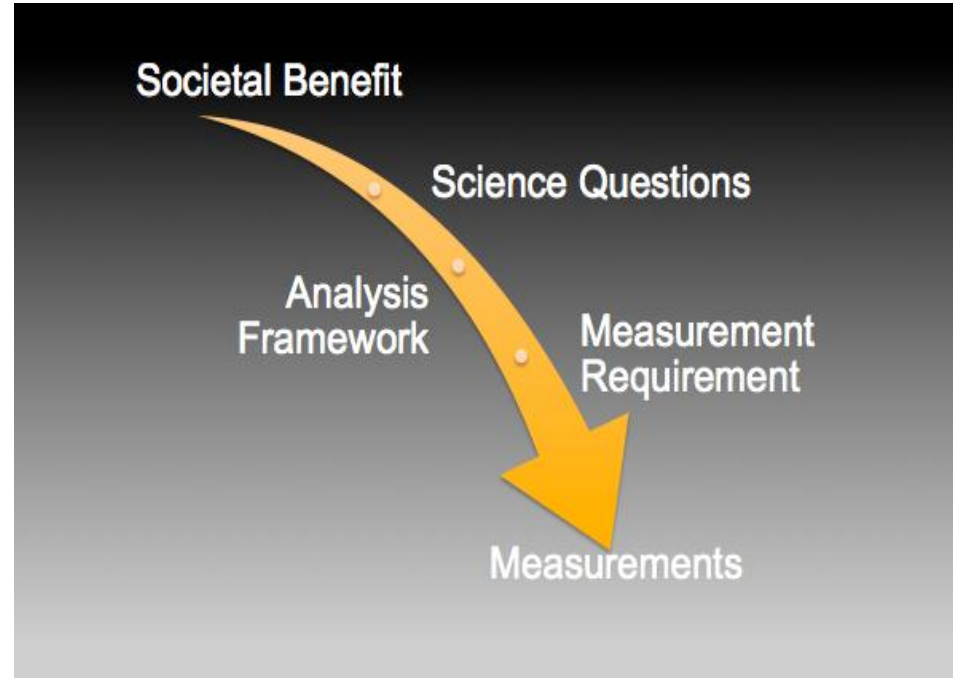
Workshop Structure

- 50 scientists in four teams – 2.5 days
 - TE/Biodiversity, Carbon Cycle, LULCC, MMT
 - Range of Earth science research institutions
 - Government agencies
- Measurements needs addressed in the context of
 - Existing data records and measurement technology (satellite, aircraft and ground)
 - Future technology and measurement approaches
- White paper
 - Distributed to other workshop groups
 - Placed online for general public

Societal Relevance

Understanding the complex, changing planet on which we live, how it supports life, and how human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity. It is also one of the most important challenges for society as it seeks to achieve prosperity, health, and sustainability....

NRC2005



Measurement Needs

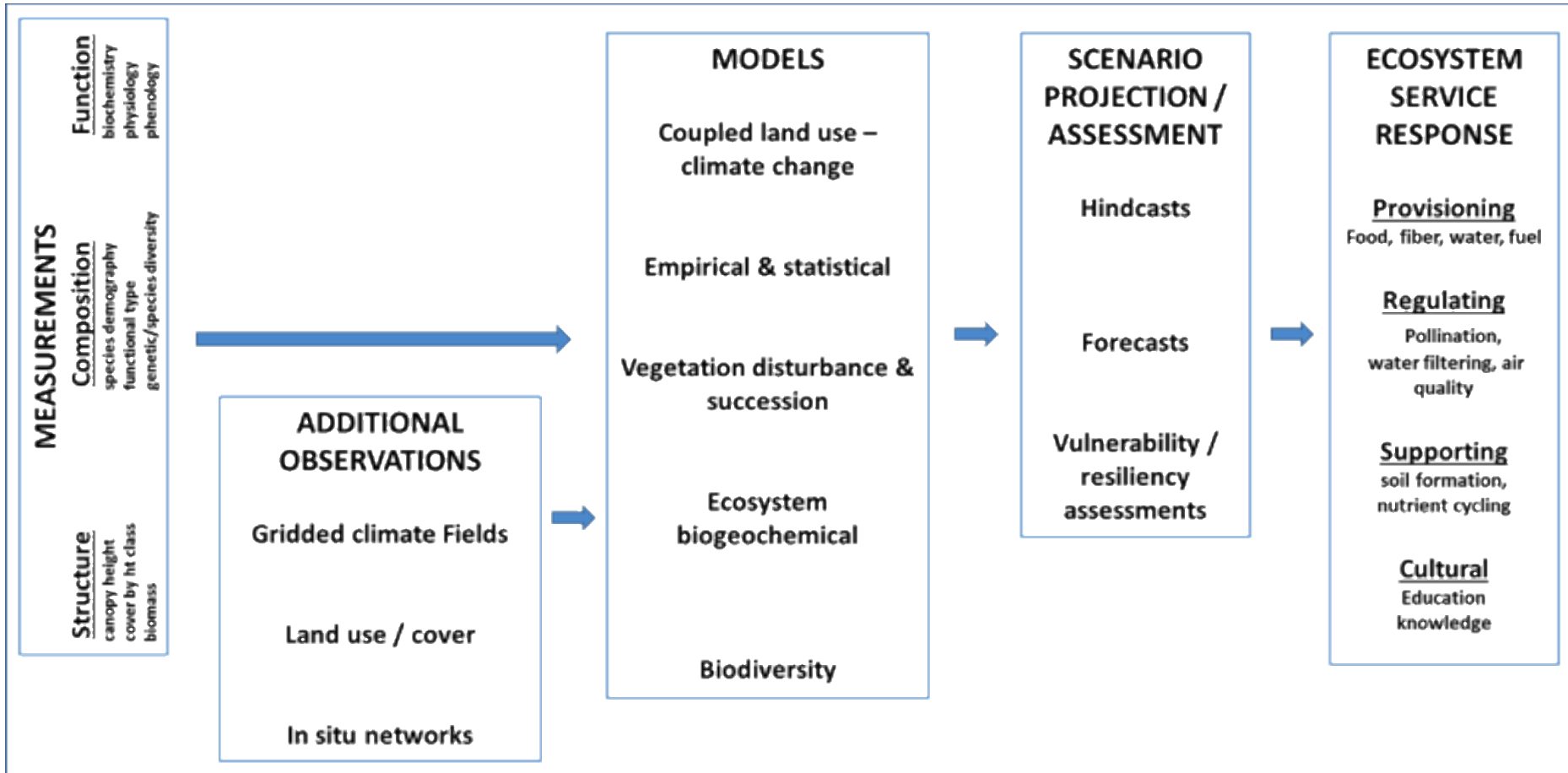
“Understanding changes and their implications requires a foundation of integrated observations taken from land, sea, air, and space based platforms – on which to build credible information products, forecast models, and other tools for making informed decisions.”

NRC 2005

Measurement Needs: (1) Land Use

- More frequent (@ 3 days) observations at 30m resolution from vis-IR
 - Supports ~weekly cloud-free observation
 - Seasonal phenology at the scale of land management
 - Crop type discrimination, crop condition
 - Land management practice
 - Stand-scale phenology
- 3D Structure
 - Improved discrimination of vegetation types
 - Forest management practice (eg. Thinning, harvest)
 - REDD+ monitoring
 - Urban infrastructure mapping
- Global Sample of high-resolution imagery
 - “simultaneous” (or “close”?) to acquisition of 30m observations
 - For calibration of land cover retrievals, and validation of products

(2) Terrestrial Ecology & Biodiversity: Analysis Framework



Measurement Needs:

(2) Ecology & Biodiversity

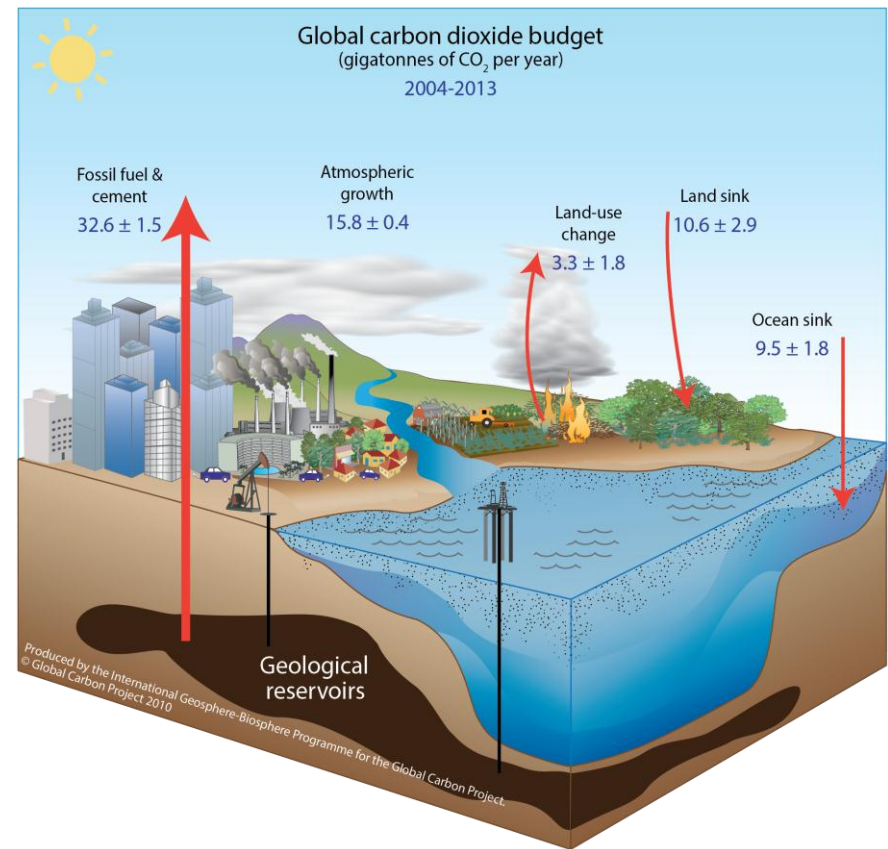
- Separate measurement suites for Structure, Function, and Composition
- Potential technical approaches include lidar, interferometric SAR, spectroscopy, multi-temporal multispectral.

Variable	Category and attributes	Measurement	Grain	Extent	Frequency	Feasibility /maturity
Structure	Canopy height, cover, density	LidarMulti-spectral time series	10 m diameter waveform footprint, 10m-30m optical	Global	Semi-monthly	Mature (We had this capability with VCL.); improvements feasible
	Biomass	Lidar, radar, multi-spectral time series	10m-30m	Global	Monthly	Mature, improvements feasible
	Leaf Area Index, Plant Area Index, Canopy bulk density	Lidar, interferometry, Spectroscopy, Multi-angle (e.g., MISR), multi-spectral time series	10m - 1 km	Global	Semi-monthly	Mature, improvements feasible
	Veg type mapping	Multispectral time series, high-res digital (e.g., Quickbird, Worldview)	5m-30m	Global	Annual	Mature, improvements feasible
Function	Vegetation Biochemistry Content of water, nitrogen, chlorophyll, other major pigments, lignin, and cellulose	Select wavelengths for vegetation indices, spectroscopy	Patch size dependent	Global	Bi-monthly minimum, higher frequency preferred	Feasible. Spectroscopy may require advanced data compression, band subselection
	Vegetation Physiology Photosynthetic rate, light use efficiency, water use efficiency, and APAR	Time series, broad band optical, select wavelengths for vegetation indices, spectroscopy	Ecosystem and patch size dependent	Global	Bi-monthly minimum, higher frequency preferred	Feasible. Spectroscopy may require advanced data compression, band subselection
	Process Phenophases and productivity	Time series, broad band optical, select wavelengths for vegetation indices	Ecosystem and patch size dependent, 30, 250, and 500 m for continuity, higher resolution preferred for phenophases	Global	Bi-monthly minimum for phenophases, higher frequency preferred	Feasible, high spatial resolution may be difficult with frequent repeat

Composition	Demographic mortality, growth, dispersion	Time series, broad band optical	30 m for continuity	Global	Annual minimum, seasonal preferred	Highly feasible and mature
	Functional species/area multiplied by function, Plant Functional Type (PFT)	VSWIR Spectroscopy	Patch size dependent, 30 m for continuity	Global	Annual minimum, seasonal preferred	Feasible. May require advanced data compression, band subselection 30 m may be difficult with frequent repeat
	Taxonomic genetic composition (species), species presence/abundance	Broad band optical, select wavelengths for vegetation indices, spectroscopy	Patch size dependent, 30 m for continuity	Global	Seasonal broad band, annual spectroscopic at peak growth season	Highly feasible & mature (broad band), spectroscopic similar to above

Measurement Needs: (3) Carbon

- measure CO₂ and CH₄ (daily to hourly);
- monitor vegetation cover and composition changes, phenology;
- indicate changes in vegetation productivity;
- measure GPP and stress-induced reductions in GPP;
- Monitor changes in vegetation biomass



Regional and Local Measurements

- More accurate, dense atmospheric carbon concentrations data over key regions,
 - Arctic/Boreal System
 - Likely a net carbon source
 - rapid arctic warming
 - mobilization of permafrost carbon pools
 - Temperate and tropical ecosystems
 - Likely a net carbon sink
- What is the vulnerability and resiliency of these ecosystems to sequester carbon and mitigate climate change?

Next Steps

- TECLUB White Paper to be published online for comment
 - Coordination with upcoming Carbon Decadal Survey Workshop (Univ. Oklahoma)
- Will be provided to NRC Decadal Survey Panels for consideration